

# PATENT SPECIFICATION



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396,162

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## COMPLETE SPECIFICATION.

### Improvements in or relating to Doors.

Communication from ELLISON BRONZE COMPANY, INC., a Corporation organised under the Laws of the State of New York, United States of America, of  
5 Jamestown, County of Chautauqua, New York, United States of America, I, ARTHUR HAROLD STEVENS, B.Sc. (Lond.), F.C.S., a Fellow of the Chartered Institute of Patent Agents, a Subject of  
10 the King of Great Britain, of the Firm of White, Langner, Stevens Parry & Rollinson, 5-9, Quality Court, Chancery Lane, London, W.C.2, Chartered Patent Agents, do hereby declare the nature of  
15 this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to doors of the  
20 type which are mounted for combined sliding and swinging movement to and from an open and closed position.

When doors of this type are used for  
service in entrances and vestibules of  
25 office and public buildings, they are required to swing outwardly and the wind pressure thereagainst often makes them extremely difficult to operate. Heretofore, door closers have often been used  
30 which exert pressure upon the doors to maintain them closed against wind pressure from the inside, as for example, due to a current of air from the vestibule. The pressure required in these door closers  
35 adds to the difficulty of opening the doors and thus frequently becomes objectionable.

An important object of the present  
invention is to provide a door of this type  
40 which is balanced by mounting it in such fashion that part of the door swings inwardly while the other part swings outwardly. In this fashion, the pressure exerted upon one side of the door is in  
45 substantial equilibrium in view of the fact that part of such pressure tends to open the door and part tends to maintain the same closed. This construction obviously requires less normal pressure to maintain  
50 the door closed and hence permits a door closer construction to be employed having a comparatively slight spring pressure.

A further object of the invention is to

provide a door of this type wherein all the parts may be conveniently contained  
55 within the door to avoid unsightly projections and irregular contours and to permit free application of architectural design.

According to the invention a door of the type set forth, includes spring means  
60 tending to close the same and preferably arranged so that the tension thereof is increased as the door is opened, which door is supported for turning movement  
65 on hinge arms at the top and/or bottom of the door and is also adapted to turn about a pivot closer to the center of the door than the point of support by the hinge arms. Preferably said pivot is in the  
70 form of a roller or the like mounted on the door and adapted to slidably engage with a channel in the door cornice. Also, if desired a device may be associated with  
75 one of said hinge arms for checking the closing of the door and preferably adapted to yieldably limit the extent to which the door may be opened.

In order that the invention may be fully understood it will now be described with  
80 reference to the accompanying drawings, in which:—

Figure 1 is a view in front elevation showing three doors with door mounting  
85 mechanism constructed in accordance with the invention, one door being open and the other two being closed;

Figure 2 is a view in section taken on  
90 line 2-2 of Figure 1, and looking in the direction of the arrows, showing the door mounting mechanism in plan.

Figure 3 is a view similar to Figure 2 showing one door moved to a fully open  
95 position and another door moved to a partially opened position.

Figure 4 is a view in section, taken on  
100 line 4-4 of Figure 2, and looking in the direction of the arrows, this figure showing the straightening out device for a door constructed in accordance with the present invention, also the door check  
105 device, adjustable hinge pin, and a device for holding the door in an open position.

Figure 5 is a view in section, taken on  
line 5-5 of Figure 4, looking in the  
110 direction of the arrows and showing a

plan view of the device for holding the door in open position.

Figure 6 is a view in section, taken on line 6—6 of Figure 4, and looking in the direction of the arrows; this view shows the upper door mounting arm secured to the top of the hinge and connected to the top of the door and also illustrates how the arms may be made in two pieces if desired, to reduce the cost of manufacturing and maintaining a stock of such arms of different sizes to be used in hinging doors of various widths at either the right or left hand edges thereof.

Figure 7 is a view in section, showing the lower bearing for the door mounting mechanism with the lower door mounting arm secured to the bottom of the hinge and connected to the bottom of the door, together with the manner of adjusting the tension on the coiled spring mounted in said hinge.

Figure 8 is a view in section, taken on line 8—8 of Figure 7, and looking in the direction of the arrows, and showing, in dot and dash lines, the door in open position.

Figure 9 is a view in section, taken on line 9—9 of Figure 7, and looking in the direction of the arrows.

Figure 10 is a view in section taken on line 10—10 of Figure 4, and looking in the direction of the arrows.

Figure 11 is a view in section, taken on line 11—11 of Figure 4, and looking in the direction of the arrows.

Figure 12 is a view in section, taken on line 12—12 of Figure 4, and looking in the direction of the arrows.

Figure 13 is a view in section, taken on line 13—13 of Figure 4, and looking in the direction of the arrows.

Figure 14 is a view in section, taken on line 14—14 of Figure 4, and looking in the direction of the arrows.

Figure 15 is a view in section, taken on line 15—15 of Figure 6, and looking in the direction of the arrows.

Figure 16 is an irregular sectional plan view taken in three parallel planes in Figure 1, as indicated generally by the arrows 16, 16.

Figure 17 is a view in section, taken on line 17—17 of Figures 3 and 16, and looking in the direction of the arrows.

Figure 18 is a view showing the mechanism for adjusting the tension on the hinge spring of the door.

Figure 19 is a view in section, taken on line 19—19 of Figure 18 and looking in the direction of the arrows.

Figure 20 is a view in section showing a modified form of the lower bearing for the door mounting mechanism in which the coil spring, like that shown in Figure

7, is omitted.

Figure 21 shows a plan view in section taken on line 10—10 of Figure 4, modified to the extent that the spring 180 is made long enough to exert pressure on the piston 124 throughout the entire opening movement of the door.

Referring to the above drawings, a door of any desired shape or design is shown at 20. A handle 21 and push bars 22 are mounted thereon in the usual fashion. The door is adapted to be swingably and slidably mounted in a suitable doorway formed by a floor 23, a cornice 24 and hollow mullions 25, on a tubular hinge 26 disposed within the mullions and upper and lower arms 27 and 28 welded or brazed at the ends of the hinge.

Referring now to Figures 7 and 8, it will be seen that a collar 30 is formed on the upper side of the lower arm 28 and is adapted to fit into the lower end of the tubular hinge 26 to which it is securely fastened or welded thereto as above described. The lower side of the arm 28 is formed to receive a ball step or thrust bearing 31 adapted to support the weight of the door 20 in a manner to be hereinafter described. Mounted in the floor 23 is a gear box 32 to which the mullions 25 and thresholds 33 are secured, see also Figures 18 and 19. A gear 34 having a hub 35 on the bottom face thereof is rotatably mounted in a bearing 36 formed in the bottom of the gear box 32, the gear 34 being held in position by a plate 37 which is fastened to the gear box by screws 38. The plate 37 surrounds a hub 39 formed on the upper face of the gear 34 and is adapted to hold the gear 34 in the bearing 36. A key 40 is secured in notches 41 formed in the sides of a counter-bore 42 cut in the upper face of the gear in any suitable manner. As here shown the key 40 is secured in the notches 41 by swaging the sides of the notches against the key, as shown at 43 in Figure 18. A stud 44, having a kerf 45 cut in the head thereof and adapted to engage the key 40, is screwed into the end of a shaft 46 against the lower race 47 of the thrust bearing 31 and is locked to the shaft by means of a pin 48. The shaft 46 is revolutely mounted in the hinge 26 in a bearing 49 formed through the hub of arm 28 and the collar 30 above described.

A spring 52, having one end disposed over a pilot 53 and located in a notch 54 formed in the shaft 46 and the other end disposed over a pilot 55 and located in a notch 56, which pilot 55 is anchored to the hinge 26 by a pin 57, serves to hold the door 20 closed or to close said door

when it is open, as will more fully appear hereinafter. The shaft 46 is held in position, with the race 47 against the balls of the thrust bearing 31, by means of a circular plate 61 and gasket 62 secured to the bottom of the arm 28 and disposed around the head of the stud 44. Oil holes 63 are provided in the hinge 26 and collar 30 for oiling the bearing 49, and the gasket 62 above described is adapted to prevent oil from leaking from said bearing. The elevation of the hinge 26 and arm 28 may be varied with respect to the thresholds 33 and gear 34 by means of packing plates or shims 64 disposed in the bottom of the counterbore 42 under the head of the stud 44.

Referring now to Figures 18 and 19 it will be seen that a pinion 67 meshing with the gear 34 is mounted in a bearing 68 formed in the bottom of the gear box 32. The pinion is provided at its center with a square hole 69 so that by means of a similarly shaped wrench or key, not shown, it may be rotated at will to turn the gear 34 and adjust the tension of the spring 52 as hereinafter described. A dog 70, urged to coact with the teeth of the gear 34 by a spring 71, is mounted in the bottom of the gear box 32, to hold the gear 34 in any desired position. A removable plate 72, see Figure 8, is fastened to the gear box 32 over the pinion 67 and dog 70, by means of screws 73, so as to give ready access to these parts for the adjustment of the tension of the spring 52.

From the mechanism thus far described, it will be seen that the hinge 26 and arm 28 are supported by the gear 34 and adapted to rotate on the thrust bearing 31 and moreover that when the pinion 67 is rotated in a clockwise direction, the gear 34, key 40 and stud 44 will be rotated in a counter-clockwise direction and put a tension on the spring 52 which will serve to urge the hinge 26 to rotate in a counter-clockwise direction and assist in closing the door 20 or to serve as a means of holding said door closed.

The upper end of the hinge 26 carries an axially movable pin 76, Figs. 4 and 13, which is received within a bearing 77, formed in the upper arm 27 and a collar or bushing 78 formed thereon. The bushing 78 of the arm 27 is welded to the hinge 26 as above described. A slot 79 formed in the hinge 26 receives set screws 80 which are screwed into the pin 76. By removing the lower set screw, see Figure 13, the pin may be dropped to the position indicated in dot and dash lines when the door is to be removed. In the position shown in solid line the pin 76 engages a bearing 81 located in one end of a

channel bracket 82 mounted within the cornice 24 and thus the door 20 is hung in a suitable manner on hinge 26 and arms 27 and 28 as above described. It will be seen from Figure 1 that the upper and lower arms 27 and 28 extend horizontally from the upper and lower ends of the hinge 26 respectively.

The extremity of the lower arm 28 is constructed to form a socket 85, Fig. 7, adapted to receive a hardened disc 86 and a cup 87. The cup 87 is provided with a convex bottom 88 and a rounded annular rib 89 for positioning it in the socket 85 on the disc 86. A downwardly extending bearing 90, carried by a bracket 91 which is secured to the bottom of the door 20 in a recess 92, is adapted to fit into the cup 87. A hardened disc 93, having a key 94 adapted to fit in a notch in the bottom of the bearing 90 and a second hardened disc 95, are disposed in the bottom of the cup 87. An oil hole 96 is provided in the bracket 91 through which the bearing 90, discs 93 and 95 may be oiled. From Figures 1, 7 and 9, it will be seen that the parts just described are adapted to furnish support for the bottom of the door 20 and that when said door is closed the arm 28 will fit into recess 92 so as not to constitute an objectionable interruption to the even surface and contour thereof.

The upper arm 27, see Figures 4 and 6, engages a shaft 99, having a squared end, for supporting the top of the door and operating a door closure and check in a manner which will be described hereinafter; the axis of the squared shaft 99 being aligned with the axis of the bearing 90 and cup 87 in order that the door may be journalled upon a single vertical axis which lies between the edges thereof.

It will be seen from Figure 15 that the faces of the shaft 99 are provided with rounded ribs 100 and adapted to fit into a hardened bearing 101 secured in the end of the arm 27 by means of rivets 102. The rib 89 on the cup 87 and the rib 100 on the shaft 99, with which the lower and upper arms cooperate respectively serve to permit these parts to properly adjust themselves, notwithstanding they may be slightly out of alignment. The swinging movement of the door 20 is therefore fixed by the hinge 26 and the vertical axis passing through the extremities of the arms 27 and 28.

The sliding movement of the door is guided by means of a ball bearing roller 103 journalled upon a stub shaft 104 mounted upon the top of the door. The roller 103 is adapted to travel in the channel bracket 82, which is mounted within a soffit of the cornice 24 by means

of screws 105, and depending lugs 106 adapted to fit into the top of the nullion 25, see Figures 4, 13 and 17. The roller 103 thus imparts a sliding movement to the door while the arms 27 and 28 impart a swinging movement thereto as above described. The arms 27—28, in combination with the portion of the door between the axis of the shaft 99 and roller 103, constitute a foggle which is utilized in a manner herein after described to facilitate the closing and opening of the door. The roller 103 constitutes a pivot which is located closer to the centre of the door than the point of support of the hinge arms.

Within the upper wall of the channel bracket 82 a detent or door holder 107 is mounted to rock on a bolt 108, see Figures 4 and 5. A finger hole 109 is formed in the detent to facilitate its adjustment to and from the position shown in Figures 4 and 17 respectively. A ball 110, urged by a spring 111 confined in a housing 112 formed on the top of the bracket 82 by means of a pin 113, is adapted to fit into depressions 114 in the face of the door holder 107 to retain said holder in an inoperative position as shown in Figure 4 or in an operative position as shown in Figure 17. A stop 115, formed on the end of the holder near the bolt 108 and stops 116 formed at the upper edge of the face of the holder, serve to limit the movement thereof to the positions above described.

Within the door, and preferably at the top thereof adjacent the shaft 99 is a cylinder 120 provided with heads 121 and 122. A coil spring 123 having a diameter adapted to permit it to be compressed against the head 122 by the axial movement of a reciprocating piston 124, Fig. 10, is mounted within the cylinder 120. The piston 124 is formed with rack teeth 125 which engage a pinion 126 mounted upon or formed integrally with the squared shaft 99 and thus relative rotation between the door 20 and arm 27 causes the shaft 99 and pinion 126 to move the piston 124 reciprocally within the cylinder 120. A piston head 127, snugly engaging the cylinder walls, is formed at one end of the piston 124, which, with the end of the cylinder that is closed by the head 121, forms a chamber within which fluid may be compressed to check the closing of the door. A duct or passage 130, see Figure 10, is formed in the piston 124 by milling a kerf 131 in the lower side of the piston 124 behind the rack teeth 125 and drilling a hole 132 through the piston head 127 into said kerf, see Figure 4, for the passage of fluid from the end of the cylinder in which the spring 123 is

located, to the compression end 133, of the cylinder. The end of the hole 132 in the piston head 127 is enlarged and formed to provide a seat 134 for a ball 135 to prevent the flow of fluid through the passage 130 when the piston is forced toward the head 121 and to permit said flow when the piston is moved toward the spring 123 and head 122. The ball 135 is retained in the opening at the middle of the hole 132 and in proximity to the seat 134 by pins 136 and 137. Obviously, other means may be employed by which the passage 130 may be made to perform the functions above mentioned and we are not to be understood to limit this part of our invention to the specific means here illustrated and described.

From Figures 4, 10, 11 and 12 it will be seen that the cylinder 120 forms a part of a casing 140 having an offset portion 141 in which the pinion 126 is housed and mounted by means to be hereinafter described. The casing 140 also comprises a fluid chamber 142 in communication with the cylinder 120 and a plate or tongue 143 extending from one side thereof to which the stub shaft 104 and roller 103 are mounted. The casing 140 is fastened to the top of the door, in an opening provided therefor, by screws 144 passing through the plate and a screw 145 passing through the back edge of the door into the body of the casing, see Figures 6 and 16.

From Figure 11 it will be seen that a bushing 146 is threaded into the top of the offset 141 to hold the pinion 126 in a bearing 147 formed in the bottom of the offset 141 and that a bushing 148 and packing 149 in the bushing 146 serve as a bearing for the shaft 99. A set screw 150 is provided to lock the bushing 146 in its proper position. Adjacent the squared shaft 99 the top of the casing is cut away at 151, see Figures 6, 11 and 16, to permit the nesting of arm 27 therein when the door 20 is in closed position.

The casing 140 and cylinder 120 are filled with a fluid medium to afford the desired gradual checking effect to the door, and the piston within the cylinder. A duct 154, Fig. 4, is formed in the casing 140 and is adapted to communicate with the cylinder 120 through the chamber 142, and ports 155 and 156 leading from said duct 154 to the cylinder. The duct 154 communicates with the region of the cylinder back of the piston head through the chambers 142 while the ports 155 and 156 communicate with the compression end, 133, of the cylinder. The outward end of the duct 154 is closed by a set screw 157. The size of the port 155 is adapted to be variably controlled by a

needle valve 158 mounted in the casing 140 in any suitable well known manner. The passage of fluid through the port 156 is controlled by ball check valve 159 which, by means of a seal 160 is sealed in position after the mechanism is assembled and ready for use. An opening adapted to be closed by a screw 161, Fig. 11, is provided for the introduction of the fluid medium, such as oil, glycerine or the like for filling the cylinder 120 and associated voids.

From the above it will be seen that when the doors shown in Figure 2 are opened to the positions shown in Figure 3 the upper arm 27 will rotate the pinion 126 in a clockwise direction with reference to the door 20; by virtue of such rotation of the pinion 126 the piston 124 will move from the compression end, 133, of the cylinder 120 toward the spring 123 and when the piston 124 comes in contact with the spring 123 it will continue so to move until the door is fully opened. The purpose therefore of the spring 123 is to cushion the door when it is suddenly opened to full open position and also to serve as a means of affording an initial assistance toward closing the door when desired. As the piston 124 is moved toward the spring 123, fluid from the spring end of the cylinder 120 will flow through the piston past the valve 135 into the compression end of the cylinder. When the door starts to close the valve 135 will close against the seat 134 and prevent the passage of fluid through the passage 130 such that the only escape for the fluid which is trapped in the compression end, 133, of the cylinder 120 is through the ports 155 and 156, the duct 154 and the fluid chamber 142 to the spring end of the cylinder. At first, such fluid will escape through both ports 155 and 156. This will continue until the piston head 127 passes and closes the port 156 and thereafter during the final closing movement of the door, all fluid trapped in the compression end of the cylinder must pass through the port 155. Having provided the needle valve 158 for controlling the size of the port 155, as above described, we are able to control the rate at which the door is finally closed.

From the foregoing, it will be seen that our door mounting mechanism comprises a spring 52, the tension of which is increased during the time the door is being opened and during the time tension is being stored in the spring 123 in the cylinder 120, so that the initial tendency toward closing the door is simultaneously supplied by the spring 52 in the hinge and the spring 123 in the cylinder. Having provided means for varying the ten-

sion on the spring 52, we are able to regulate the pressure necessary to open the door and also the spring tension, or force, which tends to close the same.

In Figure 20 we illustrate a modified form of step bearing for a tubular hinge 165, corresponding to the hinge 26 although it is not provided with a spring like that shown at 52, in the hinge 26 of Figure 7. In this form of device, a pin 166 is welded or brazed in the lower end of the hinge 165. The pin 166 is received within a cup 167. The cup 167 is externally threaded and received within a recessed member 168, having a flange 169 which is adapted to be secured to the floor 23 and preferably lies flush with the floor, as shown herein. A flush plate 170 is provided to close the recess formed by the member 168 and prevent the accumulation of foreign matter therein. The foregoing mechanism is thus received in a recess 171 within the foundation 172. The bearing cup 167 may be vertically adjusted by means of a suitable wrench (not shown) adapted to engage recesses 173 formed in the cup 167. To provide a suitable step bearing the pin 166 is mounted upon a button 174 which has a lower curved bearing surface and which is adapted to engage with a corresponding formed opposed button 175, also having a curved bearing surface. This construction provides for adjustably varying the elevation of the door above the floor. The lower arm 28 may be formed integrally with or brazed to the pin 166 and in either case adapted to cooperate with the bracket 91 as above described.

In Figure 21 we illustrate a plan view of a door closer and checking device which in all respects is like that shown in Figures 4 and 10, except that the spring 180 is longer than the spring 123 above described. We have found that when the hinge is constructed without a spring, as shown in Figure 20, that it is desirable to make the spring in the door check long enough to exert pressure on the piston 124 throughout the entire opening movement of the door. Obviously in such a construction it is desirable to have a slight initial tension in the spring 180 when the door is closed. Hence this tension will be increased during the entire opening movement of the door instead of tensioning the spring during only the latter part of such movement, as above described. In the form of the device shown in Figure 21, the tension of the spring 180 alone, is sufficient to close the door, and hold it closed.

From the foregoing, it will also be seen that a door mounting structure has been

provided which is simple of construction and of great strength. The elements are few in number and are readily assembled and afford an effective means for hanging a door at a desired height. Provision is made for swinging the door in doorways of slightly varying dimensions without requiring a material change in the structure, thus adding to the convenience of the device and the ability to standardize the parts thereof. Movement of the door to and from open and closed positions is effected with facility in view of the fact that a portion of the door swings in while another portion swings out, thus balancing the effective pressures upon the sides thereof to prevent wind pressure, etc., from resisting such movement. The toggle effect of the mounting mechanism, including the arm 27 and pivot connections of the door thereto, in addition to a portion of the door between such pivot connections and the guide rollers 103, facilitate a checking of the movement of the door as it approaches a closed position. The means for straightening out the toggle elements and thus closing the door is simple in construction and contained within the door and mounting itself, thus improving the appearance thereof and permitting doors of any design to be used. Combined with the straightening out elements is a door check described above, and a door closing spring mounted in the hinge and these devices, being formed as a unit, add to the simplicity of the structure.

While the invention has been described with specific reference to the accompanying drawings, it is not for this reason to be understood as limited save as defined in the appended claims.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, (as communicated to me by my foreign correspondents) I declare that what I claim is:—

1. A door of the type having a combined sliding and swinging movement on opening and closing, and including spring means tending to close the same and preferably arranged so that the tension thereof is increased as the door is opened, which door is supported for turning movement on hinge arms at the top and/or bottom of the door and is also adapted to turn about a pivot closer to the center of the door than the point of support by the hinge arms.

2. A door of the type having a combined sliding and swinging movement on opening and closing, which is supported on arms extending rigidly from the top and bottom respectively of a hinge hav-

ing disposed therein a spring tending to close the door and preferably arranged so that the tension of the spring is increased as the door is opened, said door being adapted to turn about a pivot engaging with a cooperating fixed member and located closer to the center of the door than the point of support by the hinge arms.

3. A door according to claim 2, in which the tension of said spring is adjustable by means preferably comprising an anchor and a shaft within the hinge to which the ends of the springs are respectively connected, said shaft being rotatable as by a gear and lockable in various positions.

4. A door according to claim 1, 2 or 3, in which the door has a roller or the like spaced from the supporting axis and adapted to slidably engage with a channel in the door cornice.

5. A door according to any of the preceding claims including a device associated with one of said arms for checking the closing of the door and preferably adapted to yieldably limit the extent to which said door may be opened.

6. A door according to claim 5 in which said check device includes means adapted to be progressively tensioned during opening of the door.

7. A door according to claim 1 in which a device associated with one of said arms for checking the closing of the door is also provided with spring means tending to close the door.

8. A door according to claim 7 comprising a recessed member adapted to be fixedly secured as to a floor, and carrying a step bearing which receives and supports the hinge, the position of said bearing in the recessed member being adjustable.

9. A door according to any of the preceding claims in which the arm secured to the bottom of the hinge engages at its extremity with a cup bearing in a bracket secured to the bottom of the door.

10. A door according to any of the preceding claims comprising a detent adjacent the path of movement of the door and adapted to be maintained either in or out of door engaging position.

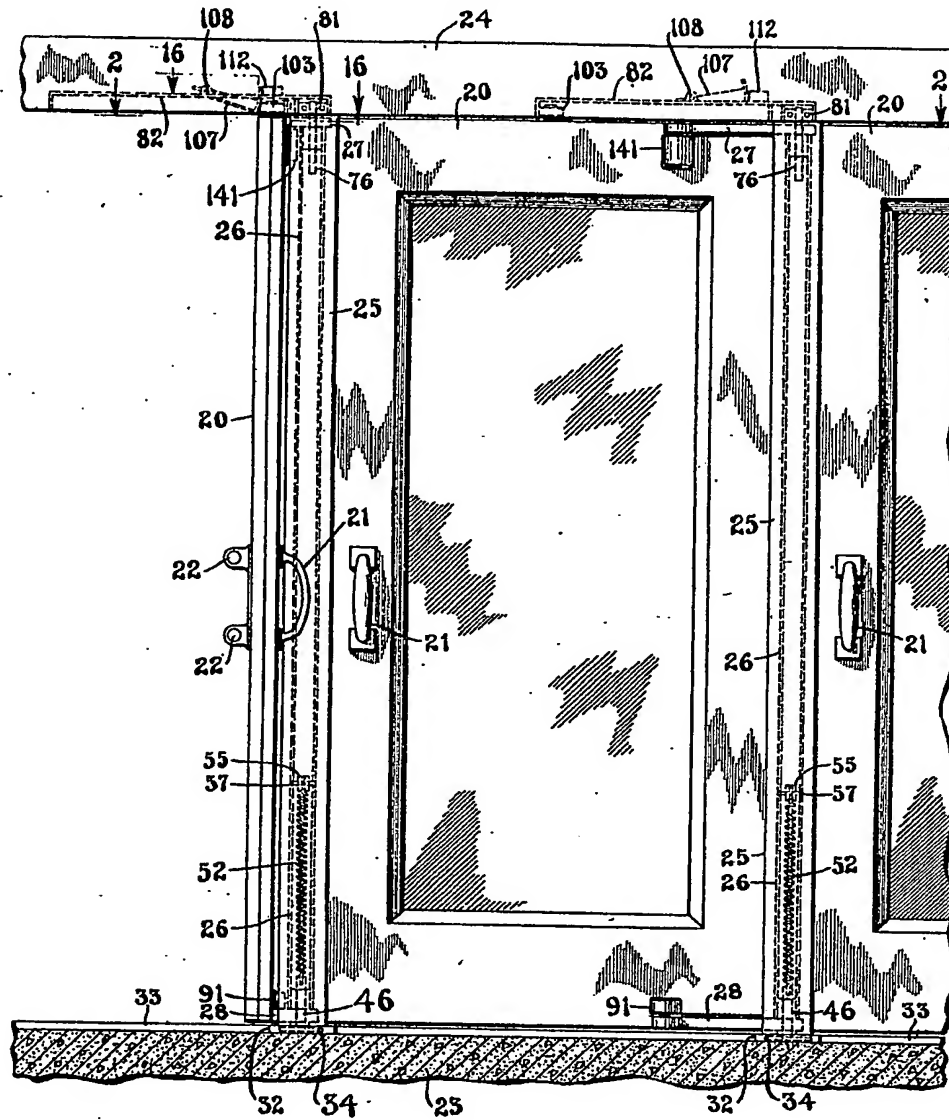
11. A door constructed and arranged to operate substantially as hereinbefore described and illustrated in the accompanying drawings.

Dated the 31st day of March, 1932.

For ARTHUR HAROLD STEVENS,  
White, Langner, Stevens, Parry &  
Rollinson,

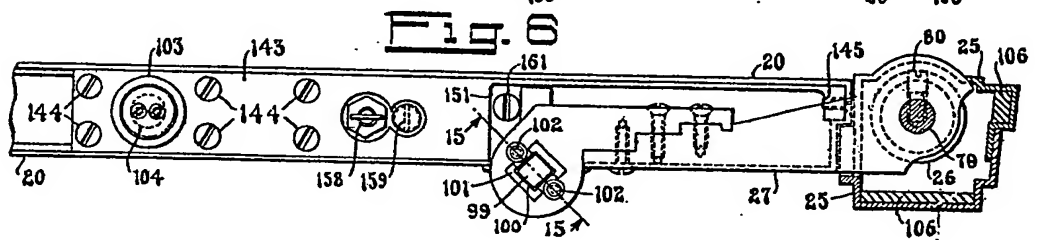
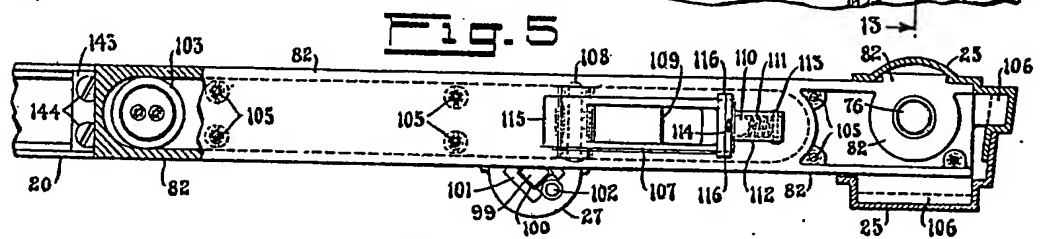
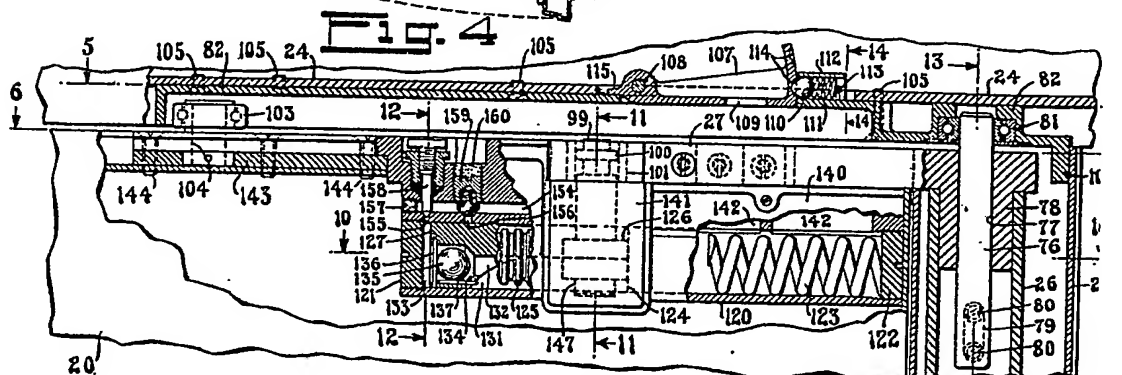
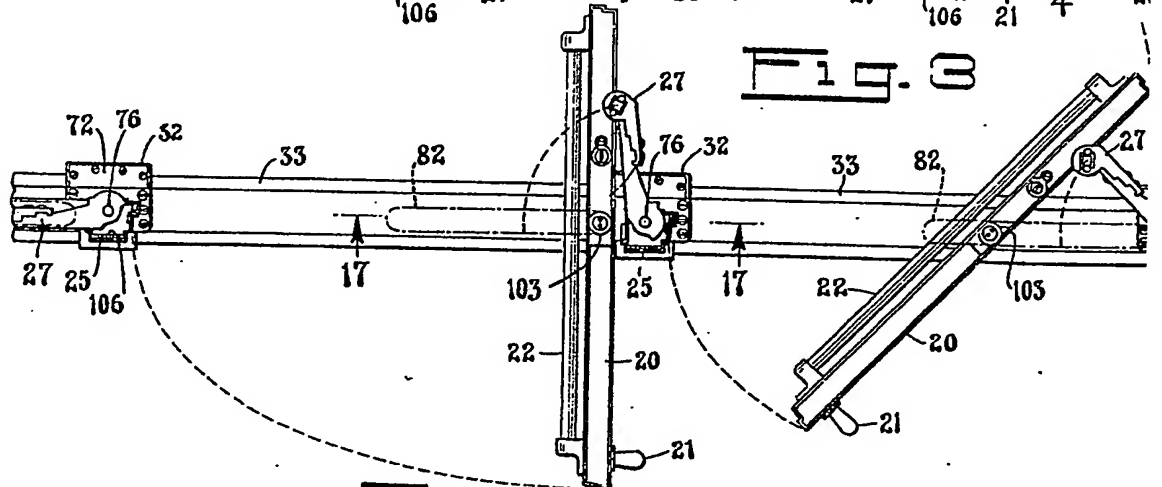
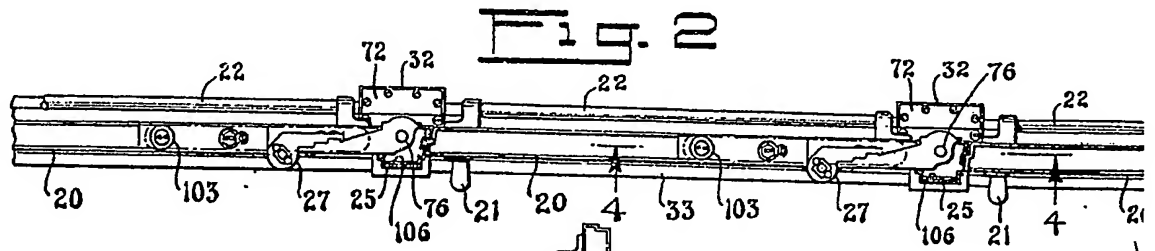
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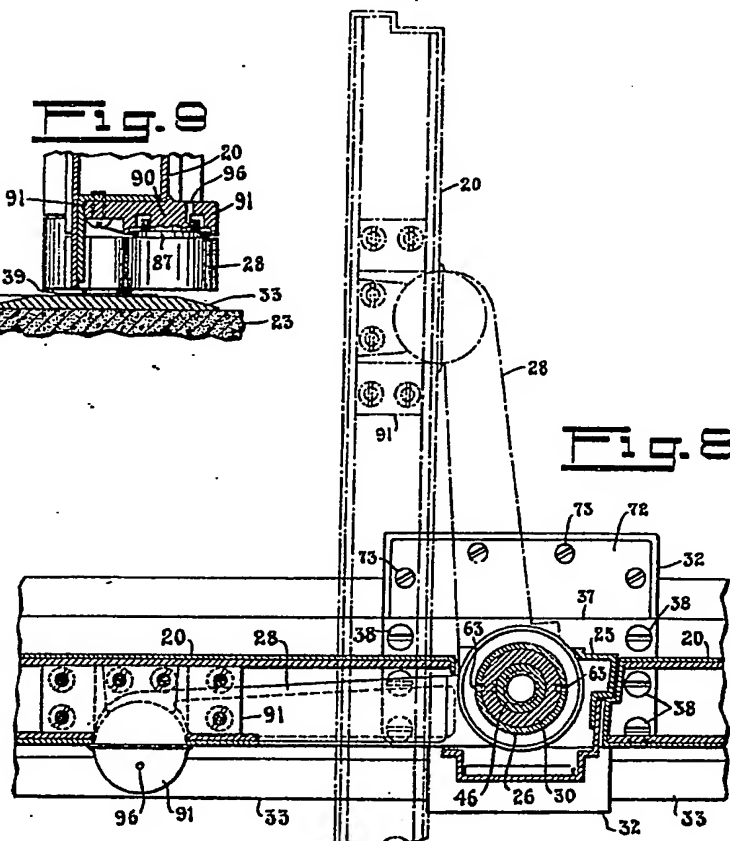
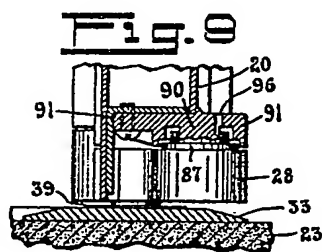
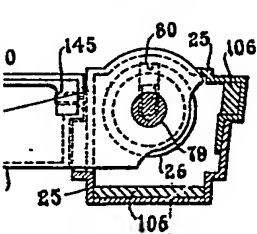
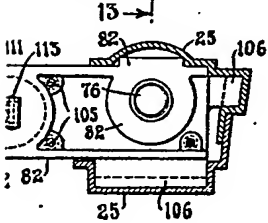
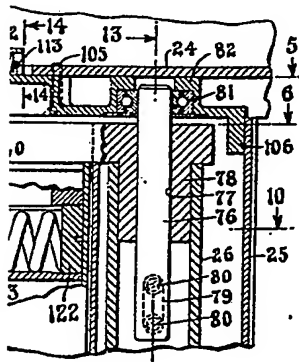
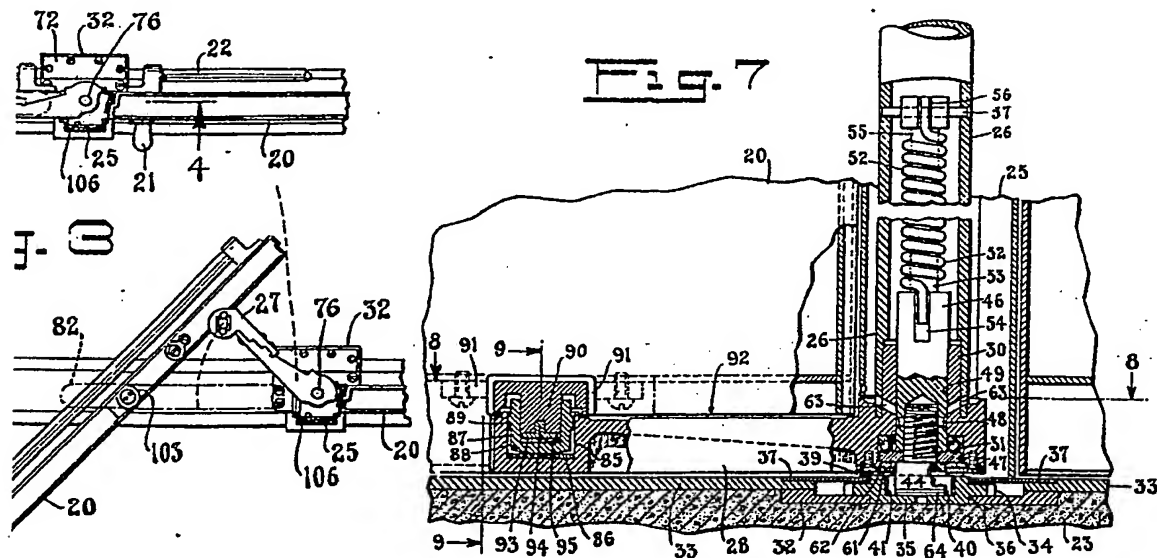
Fig. 1



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Fig. 10

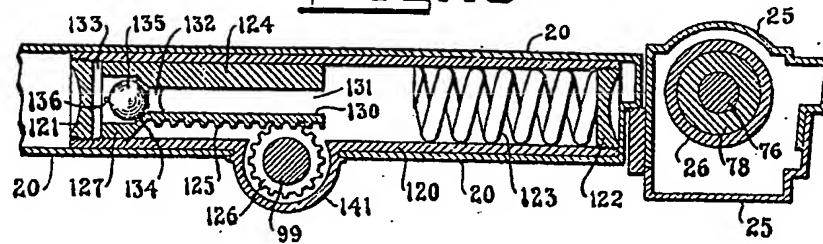


Fig. 11

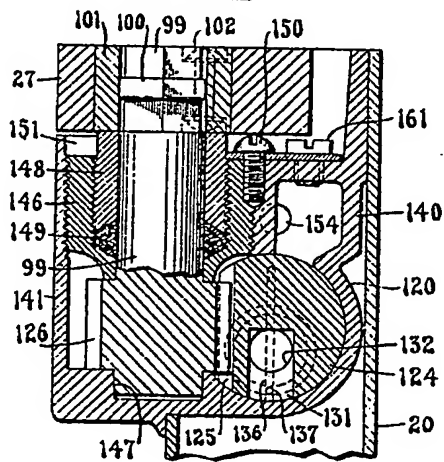


Fig. 12

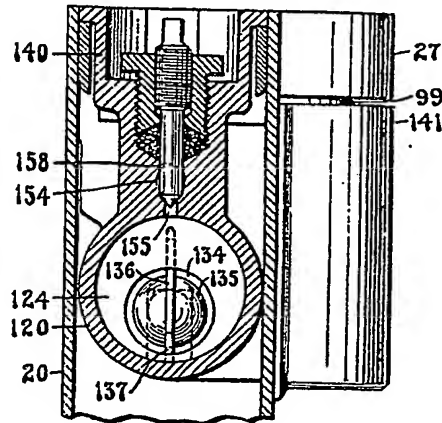


Fig. 13

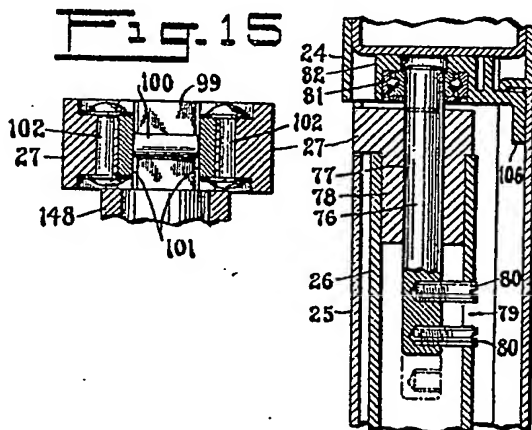


Fig. 15

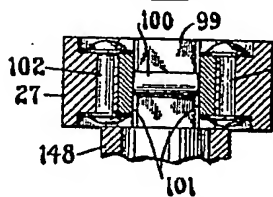
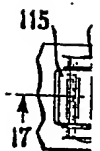
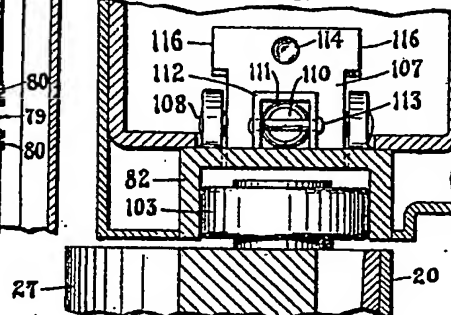


Fig. 14



[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 17

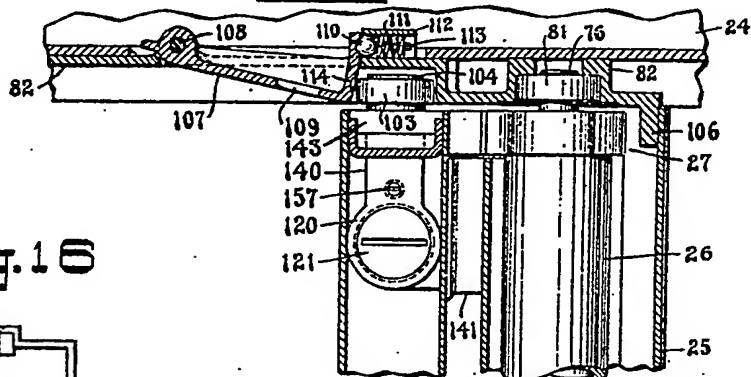
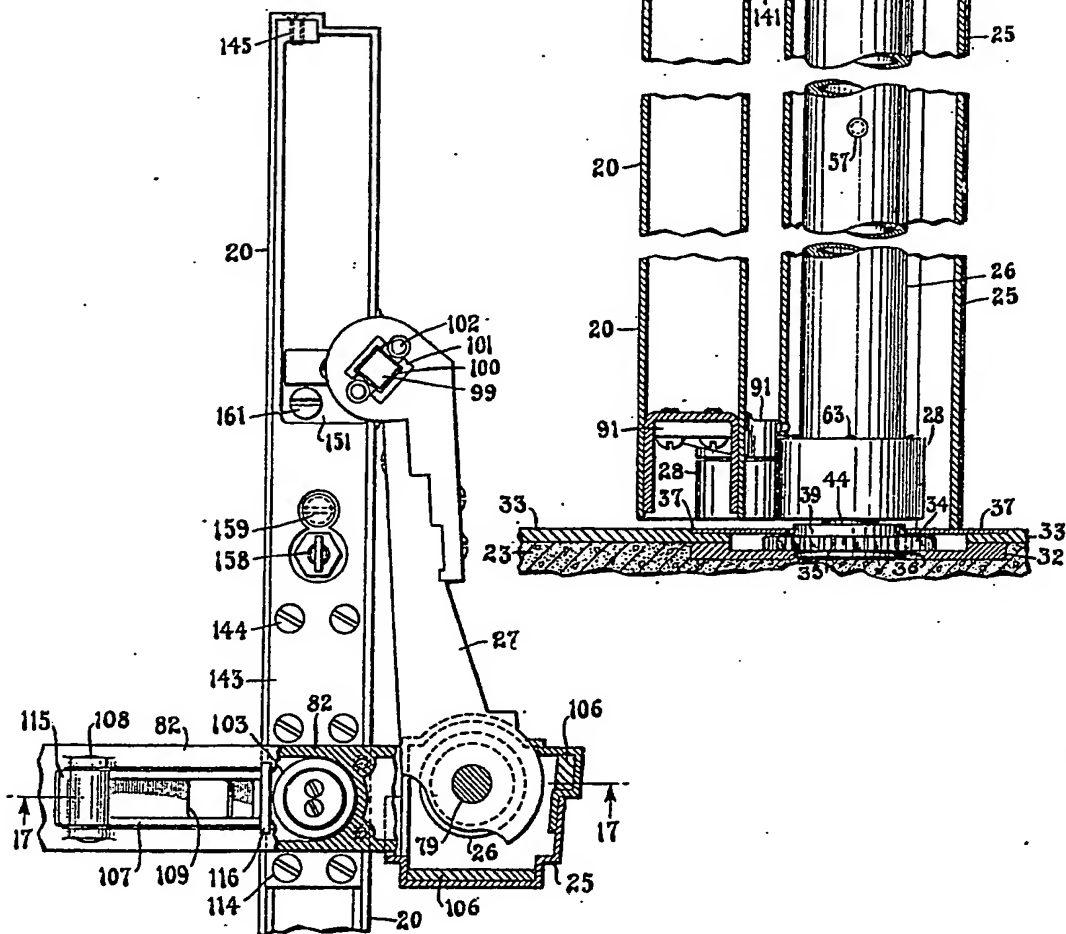
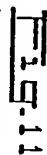


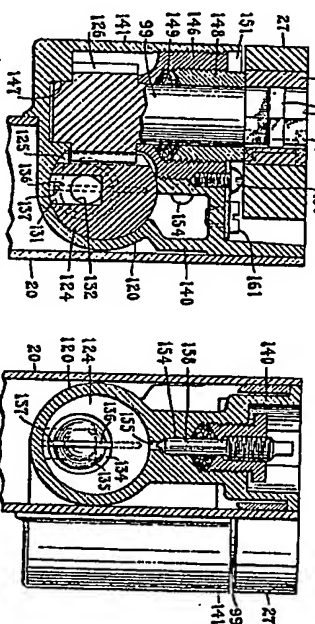
Fig. 16



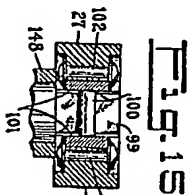
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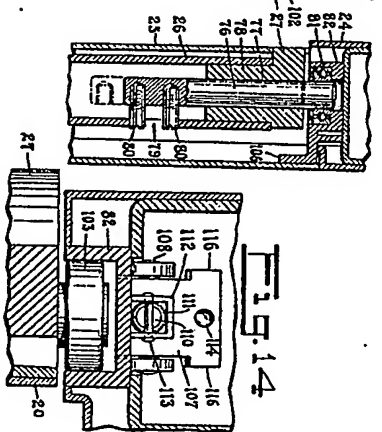
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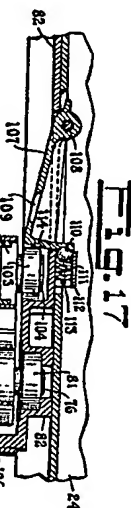
1947



10



14b



五. 17

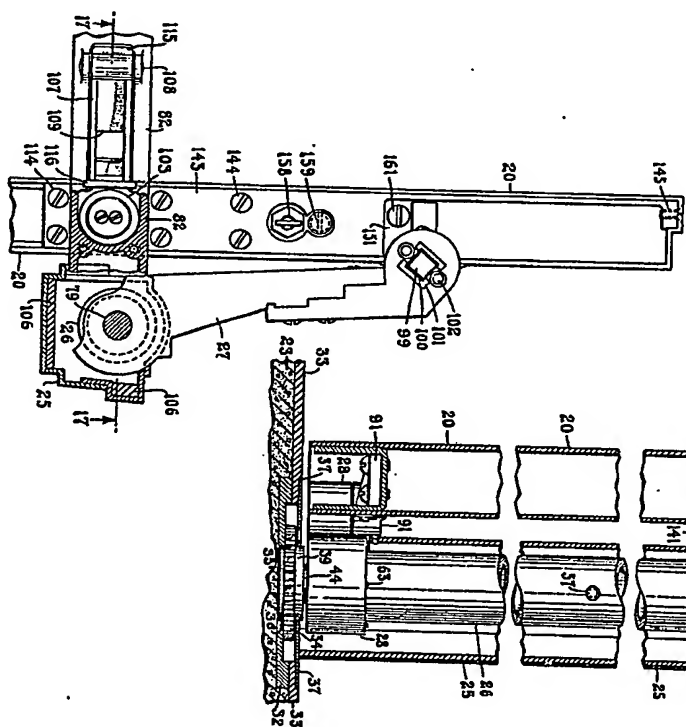
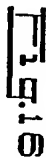


Fig. 18

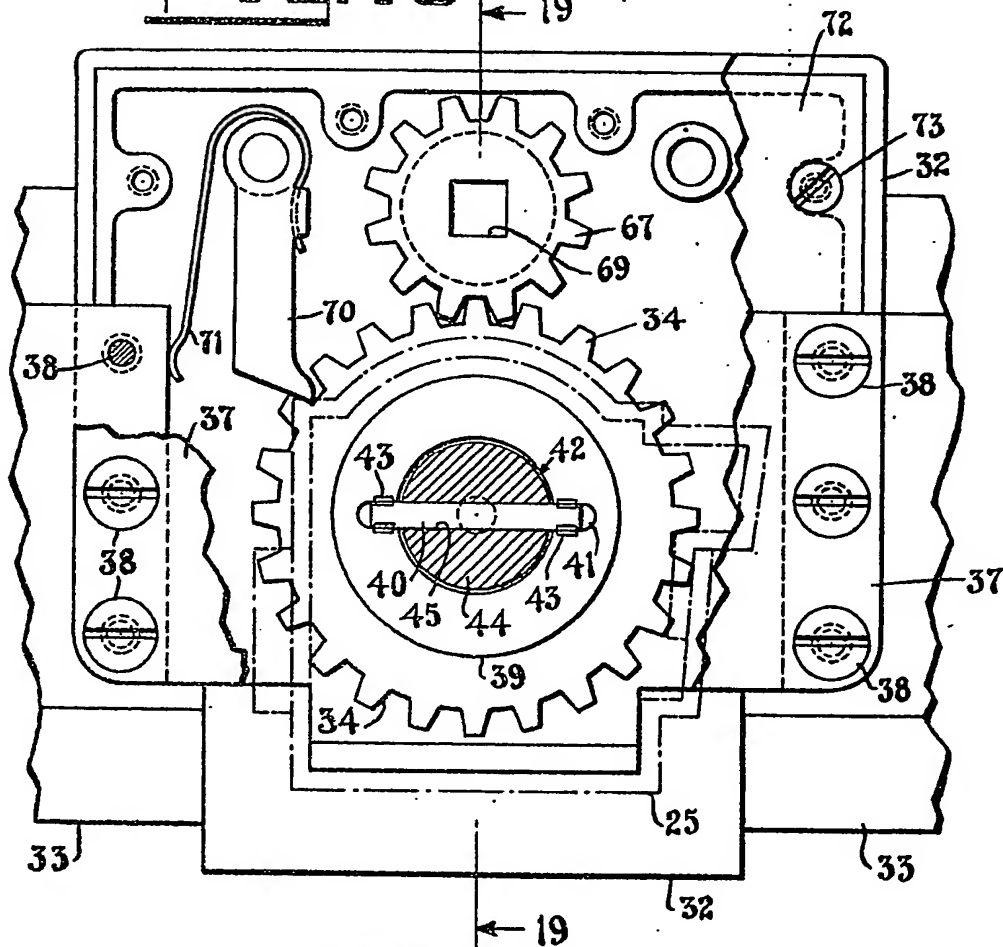
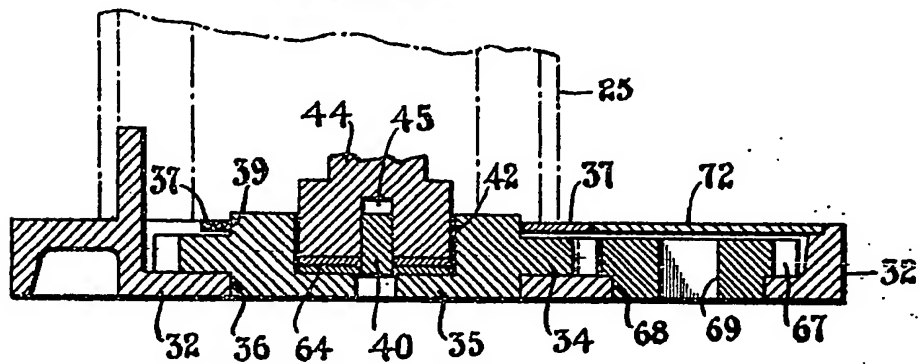


Fig. 19



[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 20

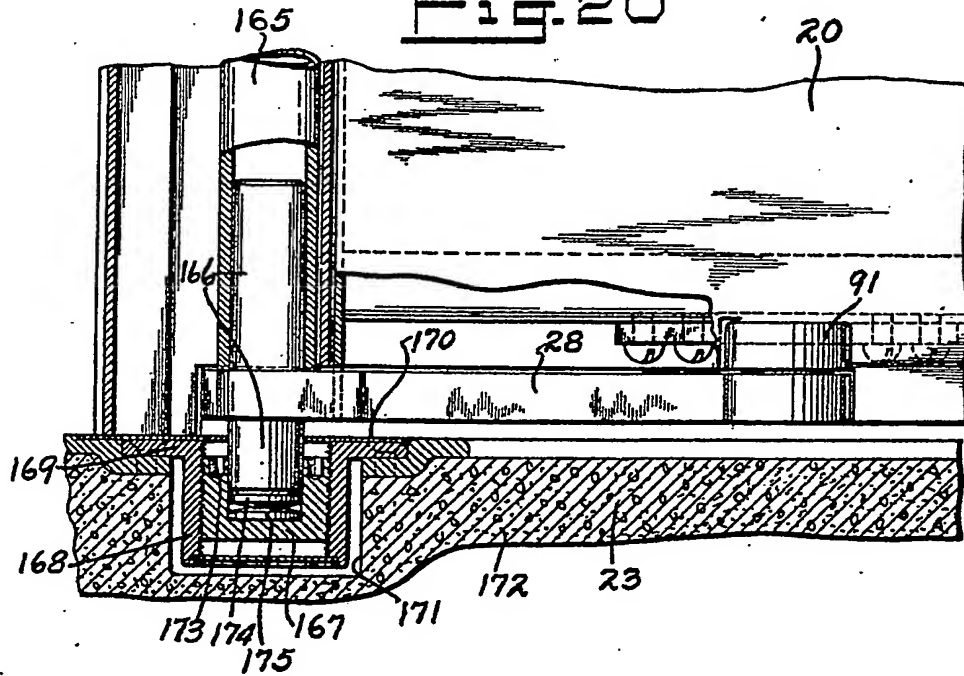
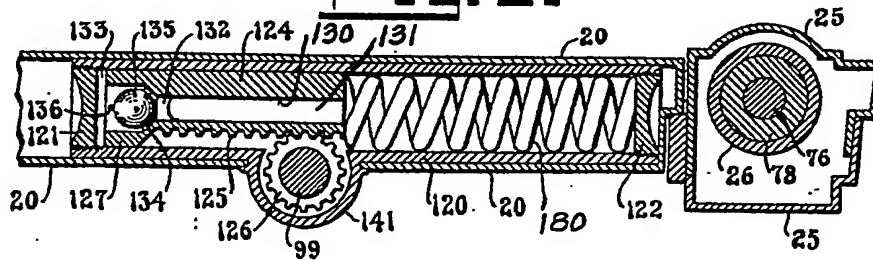


Fig. 21



[This Drawing is a reproduction of the Original on a reduced scale.]

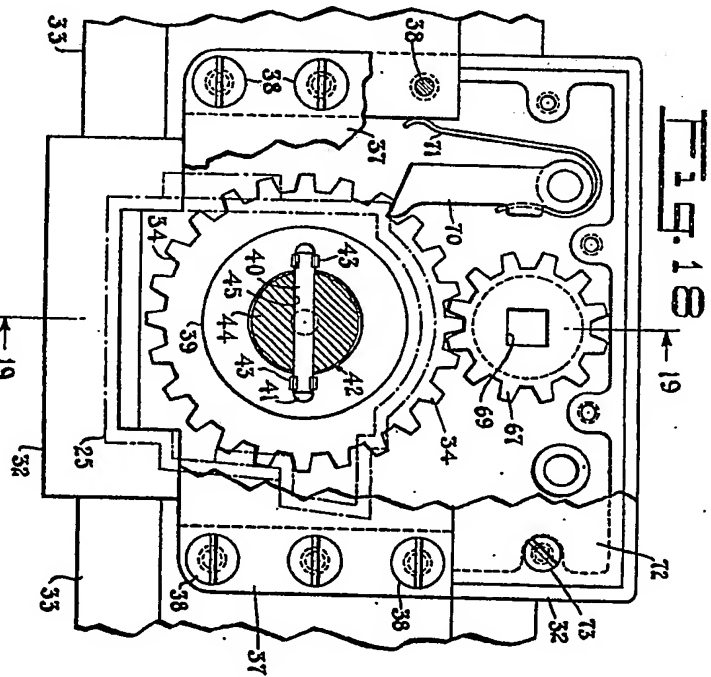


Fig. 18

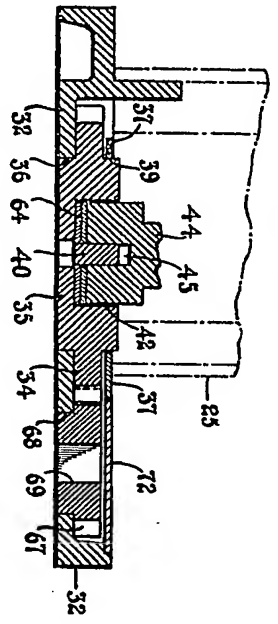


Fig. 19

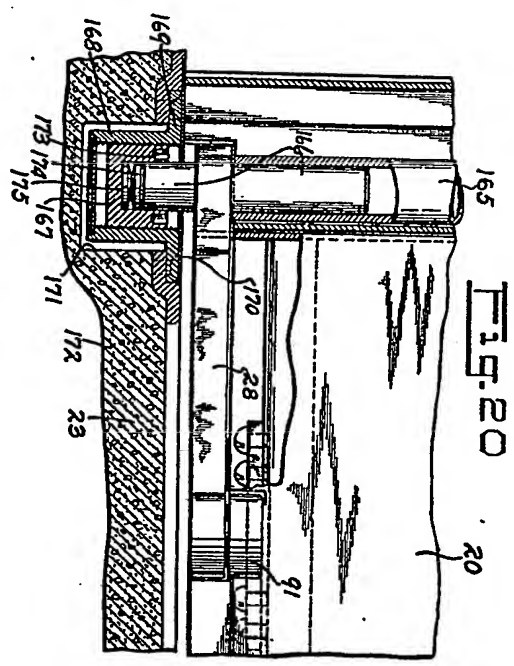


Fig. 20

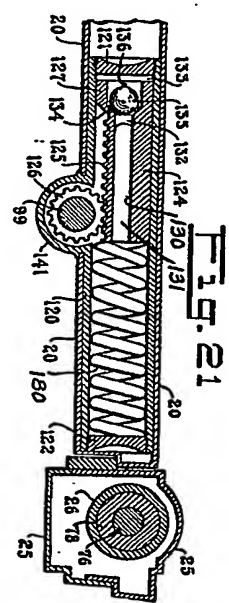


Fig. 21